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Development of Contact Lens-Type Ocular In Vivo Dosimeter For Accurate Evaluation Of Radiation Dose To Lens

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Introduction: This study aimed to develop a contact lens-type ocular in vivo dosimeter that can be worn directly on the eye and assess its dosimetric characteristics and biological stability for radiation therapy.
Methods: The molder of a soft contact lens was directly used to create the dosimeter, which included a radiation-sensitive component to measure the delivered dose. A flatbed scanner with a reflection mode was used to measure the change in optical density due to irradiation. The sensitivity, energy, dose rate, and angular dependence were tested, and the uncertainty in determining the dose was calculated using error propagation analysis. Sequential biological stability tests, specifically, cytotoxicity and ocular irritation tests, were conducted to ensure the safe application of the CLOD to patients.
Results: The dosimeter demonstrated high sensitivity in the low dose region, and the sensitivity linearly decreased with the dose. A strong dose rate dependence was not obtained for the CLOD. Angular dependence was observed from 90° to 180° with a difference in response from 1% to 2%. The total uncertainty in error propagation analysis decreased as a function of the dose in the red channel. Quantitative evaluation using the MTT assay presented no cytotoxicity. Further, no corneal opacity, iris reaction, or conjunctival inflammation was observed.
Conclusions: The CLOD is the first dosimeter that can be worn close to the eye. The results of cytotoxicity and irritation tests indicate that it is a stable medical device.

Country or Int. Organization

Republic of Korea

Affiliation

Seoul National University Hospital

Primary authors: WU, Hong-Gyun (Seoul National University Hospital); Prof. KIM, Jung-In (Seoul National University Hospital); Prof. PARK, Jong Min (Seoul National University Hospital); Prof. CHOI, Chang Heon (Seoul National University Hospital); Dr SON, Jaeman (Seoul National University Hospital); Mr CHO, Jing-Dong (Seoul National University Hospital)

Presenter: WU, Hong-Gyun (Seoul National University Hospital)

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